This document is part of Appendix A, and includes the Underwater Ship Husbandry: Marine Pollution Control Device for the "Phase I Final Rule and Technical Development Document of Uniform National Discharge Standards (UNDS)," published in April 1999. The reference number is EPA-842-R-99-001.

Phase I Final Rule and Technical Development Document of Uniform National Discharge Standards (UNDS)

Underwater Ship Husbandry: Marine Pollution Control Device

April 1999

UNDERWATER SHIP HUSBANDRY
MARINE POLLUTION CONTROL DEVICE (MPCD) ANALYSIS

Several alternatives were investigated to determine if any reasonable and practicable MPCDs exist or could be developed for controlling discharges from underwater ship husbandry activities. An MPCD is defined as any equipment or management practice, for installation or use onboard a vessel, designed to receive, retain, treat, control, or eliminate a discharge incidental to the normal operation of a vessel. Phase I of UNDS requires several factors to be considered when determining which discharges should be controlled by MPCDs. These include the practicability, operational impact, and cost of an MPCD. During Phase I of UNDS, an MPCD option was deemed reasonable and practicable even if the analysis showed it was reasonable and practicable only for a limited number of vessels or vessel classes, or only on new construction vessels. Therefore, every possible MPCD alternative was not evaluated. A more detailed evaluation of MPCD alternatives will be conducted during Phase II of UNDS when determining the performance requirements for MPCDs. This Phase II analysis will not be limited to the MPCDs described below and may consider additional MPCD options.

MPCD Options

Underwater ship husbandry activities include inspecting, grooming, maintaining, and repairing hulls and hull appendages while a vessel is waterborne.[1] Underwater hull cleaning is, by far, the most common underwater ship husbandry process and has the highest potential for environmental impact. Underwater hull cleaning is performed for numerous reasons including fuel savings, extending service life of hull coatings, and extending the interval between dry dockings and associated coating replacement. To determine the practicability of mitigating the potentially adverse environmental effects of these activities, three potential MPCD options were investigated. The purpose of these MPCDs would be to reduce or eliminate the release of antifouling agents, specifically copper and zinc, into surrounding waters during underwater hull cleaning operations. The MPCD options were selected based on initial screenings of alternate materials, equipment, pollution prevention options, and management practices. They are listed below with brief descriptions of each:

> **Option 1: Vary hull cleaning brush type and brush pressure -** The goal of this option would be to more closely match brush stiffness and pressure to the degree of fouling to minimize antifouling coating removal. More brush types would be developed, and several different brush types may be used and interchanged during the cleaning of any one vessel. By properly selecting brushes, effective cleaning can be conducted with a minimal release of antifouling agents and associated discharges.

Option 2: Mandate the maximum allowable frequency of underwater hull cleaning - This option would reduce the number of hull cleanings permissible within a given time period or at any one location to limit the amount of discharge within each harbor.

Option 3: Collect water discharged from the multi-brush cleaning vehicle - This option would provide a means to collect the discharge from the underwater hull cleaning vehicles to prevent water that contains antifouling agents from entering the surrounding environment.

MPCD Analysis Results

Table 1 shows the findings of the investigation of the selected MPCD options. It contains information on the elements of practicability, effect on operational and warfighting capabilities, cost, environmental effectiveness, and a final determination for each option. Based on these findings, Option 1 -- varying hull cleaning brush type and brush pressure -- offers the best combination of these elements and is considered to represent a reasonable and practicable MPCD.

Table 1. MPCD Option Analysis and Determination

MPCD Option	Practicability	Effect on Operational & Warfighting Capabilities	Cost	Environmental Effectiveness	Determination
Option 1. Vary Hull Cleaning Brush Type & Brush Pressure	New brush types would have to be developed so they could more closely match the hull fouling condition. Monitoring and controlling brush pressure and aggressiveness would further enhance cleaning procedures.	Using different cleaning brushes should not reduce vessel capabilities as hulls would still be required to be cleaned to current standards. However, interchanging brush types will potentially increase cleaning time, thereby slightly decreasing vessel availability.	Cleaning costs will likely increase if the brushes have to be switched more frequently or if the discharge has to be monitored. Additional costs associated with development of new brushes would be incurred.[2]	Varying brush type and pressure will reduce copper and zinc mass loading due to a reduction in brush aggressiveness by an estimated 10% to 20% depending on the age and type of antifouling coating system.[1]	Developing and manufacturing new brushes: 1) can be implemented, 2) is cost effective, and 3) will reduce mass loading. Therefore, this MPCD option warrants further consideration.
Option 2. Mandate the maximum allowable frequency of underwater hull cleaning	Pre-cleaning inspections are currently performed and compared to hull cleaning criteria to prevent unwarranted hull cleanings. Any further prohibitions on cleaning frequency could potentially negate the benefits of hull cleaning.[3]	Reducing the frequency of hull cleanings would increase hull fouling causing increased fuel consumption, decreased maximum vessel speed, and increased acoustic signature, and, therefore, adversely affect vessel mobility and readiness.	Reducing cleaning frequency will increase annual fuel costs by up to $75,000 for a typical cruiser.[4,5]	Although reducing the number of cleaning events may reduce total load, the increased aggressiveness required to clean a more heavily fouled hull could result in equal or greater total discharge. This option may necessitate more frequent paintings. Newly applied coatings have been shown to have much higher copper release rates than old coatings, so the more ships with newer coatings could increase loadings.	This option results in a performance penalty and increased fuel costs with questionable environmental benefit.
Option 3. Collect Water Discharged From the Multi-Brush Cleaning Vehicle	Installing discharge hoses on existing cleaning units does not seem to be possible due to the	Collecting effluent during cleaning operations will increase cleaning time, resulting in reduced vessel	If this option is proven to be feasible, there would be higher costs associated with: 1) technology	A new hull cleaning device has the potential to reduce mass loading of copper and zinc by 100% if	Although this option would eliminate the discharge, if the new hull cleaning device proves to be

MPCD Option	Practicability	Effect on Operational & Warfighting Capabilities	Cost	Environmental Effectiveness	Determination
	diameter of the hose required, the expected flow rate, and the head required to discharge to the pier. Operating such a device could compromise diver mobility and safety. Alternatively, a new hull cleaning device that would collect cleaning effluent is in early stages of development and the practicability of this device has yet to be determined. This effort is several years away from completion.	availability. If cleaning effectiveness is reduced, this would adversely affect acoustic signature, fuel consumption, vessel speed, and vessel mobility.	development, 2) increased cleaning time, and 3) waste treatment and disposal.	no discharge escapes collection during cleaning operations.	successful, this may become a viable alternative. Adapting a collection system to the current diver-based technology is not feasible.

REFERENCES

[1] Equipment Expert Meeting Minutes, Underwater Hull Husbandry, 22 October 1996.

[2] McCue, T. (NAVSEA Code 00C). Personal communication with K. Thomas. Estimate of Cleaning Brush Costs based on previous R&D of same. 1997

[3] Naval Ships' Technical Manual S9086-CQ-STM-010 R3 Chapter 081, Waterborne Underwater Hull Cleaning of Navy Ships. 4 August 1997.

[4] Hundley, L. L. and Tate, C. W., Sr. (David W. Taylor Naval Ship Research and Development Center). "Hull Studies and Ship Powering Trial Results of Seven FF 1052 Class Ships," DTNSRDC-80/027. March 1980.

[5] Naval Petroleum Office Instruction. July 1997.